

ATTACHMENT II-1-8

MICROENCAPSULATION PLAN

1. PURPOSE AND SCOPE

This attachment outlines the requirements for microencapsulation. The requirements in this plan apply to MICRO operations.

2. DEFINITIONS

- a. Microencapsulation ("MICRO"). For purposes of microencapsulation at the Permittee's facility, MICRO shall be defined as the process of encapsulating a non-debris waste with molten polyethylene to meet one or more of the waste's TCLP-based treatment standards or to deactivate ("DEACT") the waste.
- b. MICRO Form. MICRO Form shall be defined as waste which has been microencapsulated. The MICRO Form includes the waste encapsulated by low-density polyethylene ("LDPE").
- c. Mold. Mold shall be defined as a container in which the MICRO Form is managed immediately following encapsulation.
- d. Treatment Run. A treatment run shall be defined as the microencapsulation treatment activities for any one waste stream during one calendar day of operation, performed on a single treatment unit.
- e. Extruder. A single- or twin-screw extruder with a length-to-diameter ratio of 24:1, or greater, and auxiliary material handling equipment to weigh and feed waste and LDPE.
- f. Kinetic mixer. A mixer unit capable of mixing waste and LDPE into a molten microencapsulated mass by imparting kinetic energy.
- g. Auxiliary equipment. Equipment used to prepare waste for microencapsulation. Auxiliary equipment may include driers or size reduction mechanisms.
- h. MICRO Operations. Operations conducted to perform microencapsulation of

waste material using either an extruder or a kinetic mixer.

3. MICROENCAPSULATION TREATMENT SYSTEM DESCRIPTION AND REQUIREMENTS

- a. Microencapsulation shall be performed in the Mixed Waste Operations Building.
- b. Microencapsulation shall be accomplished using either an extruder or a kinetic mixer.
- c. Wastes that are microencapsulated using an extruder shall be able to pass through a ¼ inch nominal screen prior to microencapsulation by extrusion.
- d. Microencapsulation shall be performed on wastes that have concentrations of hazardous constituents that are within OSHA PEL exposure limits for personnel within the Mixed Waste Operations Building. The exposure evaluation shall be maintained in the operating record and shall demonstrate that the cancer health risk for non-workers is less than 1×10^{-6} .
 - i. MICRO shall have the following operational limits:
 - 1. MICRO shall be performed while the Mixed Waste Operations Building's ventilation system is operating, as specified in Attachment II-1-9, *Mixed Waste Operations Building Operating Plan*.

4. MICRO FORMULA DEVELOPMENT

- a. The Permittee shall develop a MICRO formula for each waste stream based on a full-scale performance demonstration for that waste stream. The demonstration shall show that the Permittee can successfully microencapsulate that type of waste in accordance with the acceptance criteria in this plan.
- b. Full-scale and other treatability studies may be conducted in accordance with the applicable provisions of this Permit. The results of such treatability studies may be used in conjunction with formula development.
- c. For each formula developed, verification of the applicable treatment standards shall be performed by sample analysis and the analytical results shall be kept in

the operating record.

- d. Adjustments to established formulas may be made and documented and shall include analytical verification results in accordance with Section 7.a. of this Attachment.
- e. Each MICRO formula shall specify the following operating parameters for the formula:
 - i. minimum melt index of LDPE used in the MICRO process,
 - ii. maximum waste loading by weight ratio,
 - iii. designation of microencapsulation by extruder or kinetic mixer, and
 - iv. maximum LDPE/waste ratio not to exceed five, using the calculation in Section 5.d. below, unless written approval is received from the Executive Secretary.
- f. The Permittee shall evaluate and document, during the treatability study, that each waste stream to be encapsulated will not react with the LDPE. The Permittee shall not subject wastes to MICRO treatment which are incompatible with the LDPE.

5. GENERAL MICRO REQUIREMENTS

- a. MICRO shall only be performed on waste that has a concentration based treatment standard or waste requiring deactivation (DEACT).
- b. Only one waste stream shall be treated in the same treatment run.
- c. Decontamination of the extruder or kinetic mixer between waste streams shall be performed in accordance with Section 6.e. of this plan.
- d. Dilution Monitoring. Dilution shall be calculated as follows:

$$\frac{W_b + W_a}{W_b}$$

where W_a : Weight of LDPE
 W_b : Weight of waste material to be microencapsulated
(if the waste is being reprocessed, the weight of W_b shall be the weight of the original waste material)

- e. For wastes that are candidates for microencapsulation, microencapsulation technology may be utilized to meet applicable concentration-based standards as part of a microencapsulation process, provided that the following requirements are met:
 - i. The full-scale performance demonstration for such waste shall include verification, through sample analysis, showing that the specified microencapsulation process also meets the concentration-based treatment standards. Operational parameters applicable to meeting the concentration-based treatment standards shall be specified prior to commercial treatment of a waste using microencapsulation technology. The Permittee shall follow the operational parameters for meeting those treatment standards during microencapsulation treatment.
 - ii. Post-treatment analytical testing shall be performed to verify that the applicable concentration-based treatment standards have been met.
 - iii. Samples taken for verification shall contain a representative amount of waste and LDPE, based on visual inspection or other compositional evaluation of the sample, as specified in Section 7 of this plan.
 - iv. The minimum frequency for post-treatment verification, through sample analysis, shall be in accordance with the frequencies for analytical verification outlined in Section 7 of this plan.
 - v. When disposed in a lift, the final MICRO Form shall meet the criteria for microencapsulation outlined in this plan. Any corrective action, when necessary, shall meet the requirements of this plan.

6. MICRO OPERATING REQUIREMENTS

- a. MICRO Waste Transfer, and Container Management:
 - i. Forklifts, conveyors, or other such material handling devices shall be used

to transfer MICRO Forms or containers before and after MICRO operations.

- ii. Only one waste stream shall be managed at a time in a container.
 - iii. For operations such as transfers, removals, and inspections, the container may remain open during the operation provided that an operator is present. During operation of the encapsulation equipment the container may be open provided that two people are present. The containment device shall contain the waste or MICRO Form in accordance with the applicable provisions of this Permit.
 - iv. Containers shall be used as the waste management units (molds) into which the MICRO Form is discharged. Further management of the containerized MICRO Forms shall be performed in accordance with applicable provisions of this Permit.
 - v. Protective Liners. After MICRO, a protective liner consisting of HDPE liner material with a minimum nominal thickness of 80 mils may be used as an alternative to a container associated with the following MICRO Form management activities: inspections, corrective action or removal from molds. An operator shall always be present when MICRO Forms are on the protective liner.
 - vi. MICRO Open Transfer Devices. MICRO Forms being moved to or from storage or disposal areas may be transported in an open container provided that the container has a solid floor and all sides have a containing lip with a minimum height of 1.5 inches (the width of a nominal 2"x4" wood stud). The MICRO Forms shall not be stacked more than one item high while being transported in this type of open container.
 - vii. Container Integrity. Containers (molds) shall be used which can withstand the process heat without deforming. Containers shall be reused or disposed with the MICRO product. Containers shall be inspected, and cleaned if necessary, prior to use.
- b. Preparation for MICRO Operation:
- i. Size Reduction or Waste Material Preparation for MICRO Operations.

Where size reduction or waste material preparation is necessary for waste which is to be microencapsulated, it shall be accomplished in a waste management unit in a permitted area and in accordance with the applicable provisions of this Permit.

- ii. A visual check for ice crystals and liquids shall be performed on the waste and LDPE prior to use in the MICRO process. This check shall be noted in the operating record.
- iii. If visible liquids and/or ice crystals are noticed on the LDPE, that LDPE shall not be used and the process shall cease until that LDPE can be dried or dry LDPE is substituted and used for the MICRO process.
- iv. If visible liquids and/or ice crystals are noticed on the waste to be encapsulated, that waste shall not be encapsulated until that waste has been dried.
- v. Communication Requirement. Prior to microencapsulating each waste stream, the foreman or supervisor for the microencapsulation operation shall review the MICRO formula and confer with those who will be involved with that microencapsulation to ensure that microencapsulation personnel have an understanding of the treatment parameters, operational parameters and precautions. This pre-operational briefing shall be documented in the operating record.

c. Extrusion

- i. The MICRO formula developed in accordance with the requirements of this plan shall be used for MICRO treatment.
- ii. A minimum of two people shall be present during microencapsulation operations.
- iii. Scaling Factors and Error Range for Treatment. The Permittee shall operate the microencapsulation process within the maximum waste loading ratio established by the formula. Alternatively, if the maximum waste loading ratio is exceeded, the Permittee shall take corrective action for affected MICRO Forms prior to disposal as outlined in accordance with Section 9.a. and the requirements of this plan.

- iv. Wastes may remain in the extruder following a microencapsulation activity. However, wastes shall not remain in feeders or in the extruder longer than three days following the day when microencapsulation operations were performed unless the feeder is labeled and managed as a container. If additional time is needed to remove wastes, the Executive Secretary shall be informed in writing.
 - v. Cooling Times. To allow for cooling, treated wastes shall not be disposed within 48 hours of treatment.
- d. Kinetic Mixer
 - i. The MICRO formula developed in accordance with the requirements of this plan shall be used for MICRO treatment.
 - ii. A minimum of two people shall be present during microencapsulation operations.
 - iii. Scaling Factors and Error Range for Treatment. The Permittee shall operate the microencapsulation process within the maximum waste loading ratio established by the formula. Alternatively, if the maximum waste loading ratio is exceeded, the Permittee shall take corrective action for affected MICRO Forms prior to disposal as outlined in accordance with Section 9.a. and the requirements of this plan.
 - iv. Wastes may remain in the kinetic mixer following a microencapsulation activity. However, wastes shall not remain in feeders or in the kinetic mixer longer than three days following the day when microencapsulation operations were performed unless the feeder, or kinetic mixer, is labeled and managed as a container. If additional time is needed to remove wastes, the Executive Secretary shall be informed in writing.
 - v. Cooling Times. To allow for cooling, treated wastes shall not be disposed within 48 hours of treatment.
- e. Decontamination
 - i. After one waste stream has been microencapsulated and before another

waste stream is microencapsulated, the extruder or kinetic mixer and auxiliary equipment shall be cleaned and inspected.

- ii. Visible, removable material shall be collected, placed into containers, and managed in accordance with the applicable provisions of this Permit.
- iii. A “plug” of LDPE or other non-waste material (i.e., sand, clay, or other friable solid) shall be processed through the extruder or the kinetic mixer and other portions of the MICRO waste feeding system which cannot be wiped down to ensure removal of the waste material from the processing of the previous waste stream. This “plug” of material may be accompanied by an acrylic purge compound to help capture excess waste material deposited within the equipment. For the extruder, the plug shall be a minimum of two feet of LDPE processed through the length of the extruder. For the kinetic mixer, a minimum of three normal loads of material shall be processed by the kinetic mixer.
- iv. During the cleaning process, the non-waste material exiting the equipment shall be visually inspected to determine if any waste is entrained in the material. Non-waste material shall be processed through the equipment until the visual inspection determines that no waste is entrained within the “plug” of material. The plug of material shall be managed with the waste stream.
- v. If the subsequent waste is incompatible with the previous waste, feeders and waste handling equipment shall also undergo a triple waste-removal effort involving three successive surface “wipe-downs” followed by checks for dryness. “wipe-downs” consist of the use of damp cloth or other absorbent material to clean surfaces that have been in contact with the waste.
- vi. These inspections and “triple rinsings” shall be documented in the operating record.
- vii. Waste generated during decontamination process shall be managed as hazardous waste including PPE and materials generated by wipe downs.

7. ANALYTICAL VERIFICATION REQUIREMENTS FOR MICRO

- a. The Permittee shall verify treatment by sampling and analyzing microencapsulation treatment residues in accordance with the minimum frequency outlined below, using EPA-approved analytical methods performed by a Utah certified laboratory:
 - i. One verification sample from each of the initial six treatment runs for each waste stream, thereafter,
 - ii. One verification sample from ten percent of the treatment runs until 15 treatment runs have been tested, thereafter,
 - iii. One verification sample from five percent of the treatment runs
- b. Verification samples shall contain a representative amount of waste and LDPE, based on visual inspection, i.e., color, composition, consistency. Verification samples shall be obtained from the MICRO Form after it has been discharged from the unit. A verification sample shall be composited from a minimum of three separate samples, containing a minimum of 100 grams per sample.
- c. When a verification sample is taken during the MICRO process, the sample shall be cooled prior to analysis.
- d. Off-site wastes, which are sent to the Permittee for microencapsulation and which are accompanied by a certification from the generator or a treatment facility that some of their applicable treatment standards are met, are not required to be tested for those concentration-based treatment standards for which a certification establishes that those treatment standards have been met provided that:
 - i. The Permittee has confirmed through the treatment formula development that the waste meets the LDR Treatment Standards certified by the generator, and
 - ii. The Permittee has confirmed that any additional treatment that is to be performed shall not cause previously certified constituents to mobilize, and
 - iii. The waste meets the Permittee's incoming waste acceptance criteria.

- e. Disposal Following Verification. Wastes for which verification has been completed may be disposed in accordance with the applicable provisions of this Permit.
- f. Should unsuccessful MICRO occur, the associated MICRO Forms shall be further treated to meet the applicable standards prior to disposal. Formula development requirements shall be followed for such further treatment. Upon further treatment, the sampling frequency of Section 7.a. shall be restarted, as if the waste was a new waste stream.
- g. For each MICRO Form, whenever the maximum waste loading is exceeded during the extrusion process, a verification sample shall be taken to ensure that the treatment standards are met for that MICRO Form.

8. DISPOSAL REQUIREMENTS FOR MICRO

- a. MICRO Forms shall be placed in the Mixed Waste Landfill Cell only after being approved and certified to meet the applicable treatment standards prior to disposal.
- b. MICRO Forms shall not be stored or disposed in a manner which exposes them to sunlight for more than 90 days.

9. CORRECTIVE ACTION

- a. Corrective action or contingency measures shall be taken for each MICRO Form, treatment run, or set of treatment runs that fails to meet the applicable treatment standards. For such cases, corrective action shall be taken for MICRO in one of the following ways in accordance with the applicable provisions of this Permit:
 - i. Repeat MICRO. The MICRO Form shall be size reduced as necessary and microencapsulation shall be repeated. Any necessary adjustments to the MICRO formula shall be made in accordance with Section 4 of this plan.
 - ii. Stabilization. The MICRO Form shall be size reduced as necessary and stabilization shall be performed. Stabilization formulas shall be established in accordance with the applicable provisions of this Permit.

- iii. Alternative Management. Alternative management may include manifesting the waste to another treatment, storage or disposal facility or storing the waste pursuant to future management in accordance with the applicable provisions of this Permit.
- iv. Corrective actions shall be documented in the operating record.

10. RECORDKEEPING

- a. The Permittee shall maintain documentation in the operating record of microencapsulation treatment operations and of other requirements in this plan for a period of three years.
- b. Microencapsulation operation documentation shall include:
 - i. Generator Number
 - ii. Waste Stream Number
 - iii. date and time of MICRO
 - iv. quantities of waste treated
 - v. operators initials
 - vi. treatment formula,
 - vii. analytical results
 - viii. a certification of treatment based analytical results
- c. All wastes which are microencapsulated shall retain a signed Certification of Treatment in accordance with UAC R315-13-1. Certifications shall be kept for a period of five years.
- d. Microencapsulated waste shall be tracked in the operating record in accordance with Attachment III-2, *Waste Identification and Tracking Plan*.

END OF ATTACHMENT II-1-8